

REMARKS

This invention relates to a method of decomposing a thermosetting resin, and to an apparatus and a heat control program for carrying out the method.

The rejections of Claims 1, 2, 4-6, 8-12, and 17 under 35 U.S.C. § 102(b) as anticipated by U.S. 3,954,681 (Castle), and of Claims 13-16 under 35 U.S.C. § 103(a) as unpatentable over Castle in view of U.S. 5,616,623 (Münzmay et al), are respectfully traversed.

As described in the specification under "Description of the Background," beginning at page 1, line 8, processes exist in the prior art for decomposing thermosetting resins such as urethane resins, but they have been problematical, such as the requirement of inordinate amounts of time. The present invention addresses these problems.

As recited in above-amended Claim 1, the invention is a method of decomposing a thermosetting resin by a decomposer, comprising the steps of:

only pre-heating the thermosetting resin up to a preheating temperature T0;
kneading the pre-heated thermosetting resin together with a decomposer, and concurrently heating a mixture comprising the thermosetting resin and the decomposer up to a kneading temperature T1, thereby allowing a reaction to take place between the decomposer and the thermosetting resin to obtain a kneaded matter wherein the decomposer becomes consumed; and heating said kneaded matter to a maximum temperature T2 to decompose the thermosetting resin; wherein: said pre-heating temperature T0 is not higher than the boiling temperature of said decomposer; said kneading temperature T1 is not lower than said pre-heating temperature T0 but is lower than the thermal decomposition temperature of the thermosetting resin; said maximum temperature T2 is lower than the thermal decomposition temperature of the thermosetting resin; and said pre-heating of the thermosetting resin is performed under the following conditions of temperature T0 and time t:

$$100^{\circ}\text{C} \leq T_0 < 260^{\circ}\text{C}$$

$$0.5 \text{ min} \leq t \leq 7 \text{ min.}$$

The importance of both T_0 and t is demonstrated in the comparative data of record. See, for example, Tables 1 and 2, at pages 26 and 27 of the specification, respectively, for Comparative Examples 1-3, compared to Example 1. Additional comparative data appears in the specification. See the description regarding Comparative Examples 4-6, and Examples 2-33. The comparative results could not have been predicted by the applied prior art.

Castle discloses a method of reclaiming cured polyurethane elastomers wherein the cured polyurethane elastomers are first put into fine particulate form, such as by soaking the elastomer in a suitable solvent to swell the polyurethane at least to a semi-brittle state so that it can be very easily crumbled to fine particle size and then removing the solvent (paragraph bridging columns 2 and 3); milling the particulate cured polyurethane under shear sufficient to generate an elevated temperature, preferably at least about 120°F and to cause the particles to form a coherent mass (column 3, lines 25-28), which may be carried out relatively rapidly such as for about two minutes or so (column 3, lines 49-53); initiating devulcanization by adding a devulcanizing agent which is a suitable aliphatic alcohol, water, or mixture thereof to the cohesive mass (paragraph bridging columns 3 and 4), wherein the operating conditions increases the temperature during the devulcanizing step to between about 120°F and 280°F (column 4, lines 31-34). In Example 1 therein, the cohesive mass is subjected to a temperature of about 220°-270°F, while the mass is being mixed in a mixer under compression, whereby water is added to the mixture and mixing is continued for 15 minutes.

It is clear from Example 1 that water is present as a devulcanizing agent therein. Other devulcanizing agents are used in some of the other examples, although it is noted that contrary to the finding by the Examiner, butanediol used in Example III is used as a curing agent, not a devulcanizing agent.

Castle neither discloses nor suggests the presently-claimed invention. Castle neither discloses nor suggests a pre-heating step, *per se*. In Castle, prior to carrying out devulcanizing, heating is carried out during the milling step, and optionally during the swelling step (column 3, lines 1-3). Castle neither discloses nor suggests the simple expedient of pre-heating, as recited herein, prior to kneading a pre-heated thermosetting resin together with a decomposer, and the superior results obtained thereby, as demonstrated in the specification and discussed above.

Münzmay et al does not remedy the deficiencies of Castle. Münzmay et al has been relied on for a disclosure of compounds, such as various ethanol amines and other amino alcohols, that react with polyurethanes for purposes of decomposing them. Münzmay et al is specifically concerned with compounds that contain at least two isocyanate-reactive hydrogen atoms. Such compounds include diols and triols, also disclosed by Castle. But without the present disclosure as a guide, one skilled in the art would not have combined Castle and the disclosure of ethanol amines in Münzmay et al, since Castle is limited to water and alcoholic devulcanizing agents. Moreover, even if these references were combined, the result would still not be the presently-claimed invention.

For all the above reasons, it is respectfully requested that the rejections over prior art be withdrawn.

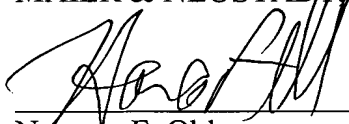
Applicants gratefully acknowledge the Examiner's indication of allowability of the subject matter of Claims 3 and 7. Nevertheless, Applicants respectfully submit that all of the presently pending and active claims in this application are in immediate condition for

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allowance. Accordingly, the Examiner is respectfully requested to pass this application to
issue.

Respectfully submitted,

OBLON, SPIVAK, McCLELLAND,
MAIER & NEUSTADT, P.C.



Norman F. Oblon
Attorney of Record
Registration No. 24,618

Customer Number

22850

Tel: (703) 413-3000
Fax: (703) 413 -2220
(OSMMN 08/03)
NFO/HAP/cja

Harris A. Pitlick
Registration No. 38,779